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NEW UNITS OF ELECTRICITY AND LIGHT

The introduction of absolute units in electricity and the new system of units of light, which was to have taken place on January 1, 1940, in accordance with decisions of the International Committee on Weights and Measures, must now await resumption of normal international relations. Although the new methods of defining the units will be fundamentally different from the old, the actual size of the units will not be changed enough to affect seriously present commercial usage in the United States. It would be possible to make the change independently, but one of the principal purposes of the proposed change is to obtain and to maintain closer agreement between the units used in different countries; this purpose would be defeated by separate action of one country.

Early in 1939 it became evident that final agreement upon values for the units could not be reached soon enough to permit their use at the beginning of 1940. (See Technical News Bulletin 265; May 1939.) In particular, the German national laboratory, the Physikalisch-Technische Reichsanstalt, had not completed its absolute measurements of electric current, and some German authorities had questioned the validity of the spectral luminosity factors which had previously been accepted as the basis for photometry of lights differing in color from the primary standard (a black body at the temperature of freezing platinum). It was hoped, however, that these difficulties might be resolved to such an extent that the General Conference on Weights and Measures, meeting in October, could at least set a new date for adoption of the new units.

At meetings of the International Advisory Committee on Photometry and of the International Commission on Illumination, held in June 1939, unanimous agreement was reached to retain the accepted luminosity factors and to complete the system of practical photometric standards derived from the platinum black body by means of those factors. International comparisons of gas-filled incandescent standard lamps

[1] Published with the approval of the Director of the Budget.

were to be made, so that the new units could be introduced for all types of lamps in all countries on January 1, 1941.

On the electrical units no such definite recommendation could be made, because the German measurements of current were not finished and preliminary results were not concordant with those obtained in other countries. Arrangements were made for direct comparisons of apparatus between the Reichsanstalt and the National Bureau of Standards in order to find the cause of the discrepancies in results.

The war has, of course, prevented the execution of these plans. The meetings of the International Committee and the General Conference on Weights and Measures scheduled for October were canceled and no progress toward international agreement on the units can be made until peace is restored. In the meantime the Bureau is continuing experiments to confirm or correct its own determinations of the electrical units. In photometry, the results of international comparisons so far as they were completed were satisfactory.

INDUSTRIAL USES FOR SILVER

The American Silver Producers' Research Project issued its Tenth Progress Report November 1, 1939. This report reviews the progress made since release of the Ninth Progress Report dated July 1, 1939, reviewed in Technical News Bulletin 268 (August 1939).

During the past half year several companies have been following up the work of the Project on the lining of cans with vaporized films of silver. Studies are being continued at the Bureau to evaluate the merit of various types of can linings as a foundation upon which a silver film may be deposited. Some can linings have been produced with very thin films of silver which have a mirror-like appearance and resist peeling when in contact with certain beverages. As the value of the silver used in such linings is only a small fraction of a cent per can, this phase of the work has aroused considerable commercial interest.

The study of electroplated silver coatings has been continued, and good deposits of silver have been made at 240 amperes per square foot current density. The rate of deposition of silver in some experiments was forty times the normal rate. These high-current densities are possible under conditions involving a turbulent flow of the electrolyte. In order to silver-plate containers, for example, using automatic machinery, it appears necessary to use methods requiring high rates of silver deposition.

The possibility of electroforming complicated shapes, such as distilling flasks, has been demonstrated, and several silver flasks have been produced by the method of electroforming.

A study has been made of the embrittlement of steel as a result of cleaning and plating operations.

The metallurgical program has included the preparation and study of alloys of silver with small amounts of the following metals: Arsenic, antimony, aluminum, magnesium, manganese, nickel, silicon, and zinc. The properties of bronzes and of lead and tin containing small amounts of silver have been determined. The Tenth Progress Report presents data relating to these metallurgical studies.

A comprehensive study is being made of the effect of silver in amounts up to 0.15 percent upon the properties and performance of antimonial-lead storage batteries.

All of the above work is being undertaken at the Bureau. In addition, work is continuing at Rensselaer Polytechnic Institute, Cornell University, and Lehigh University. The Rensselaer Polytechnic Institute data are being accumulated so that silver graphite brushes can be compared in performance with conventional brush materials. At Cornell University attention has been focused on obtaining a fungicidal silver spray of suitable adhesiveness. The toxicity of silver for fungous organisms has been demonstrated by the use of silver sulfate in a mildew preventive paint. Similarly, antifouling paints containing silver salts have shown some promise.

At Lehigh University, the resistance of silver to various industrial corrosives is being compared with the corrosion resistance of metals now used industrially. Data have been accumulated dealing with the corrosion resistance of silver to sulfuric acid, hydrochloric acid, phenol, acetic acid, sodium hydroxide, phosphoric acid, hydrofluoric acid, and acid mine water. Much of this work has been carried on at the suggestion of companies facing a particular corrosion problem. Additional suggestions of this nature will be welcomed.

A book entitled, "Argyria—The Pharmacology of Silver," by Pillsbury and Hill has been published recently by Williams & Wilkins Co., and presents the results of the silver research fellowship at the University of Pennsylvania relating to this subject.

In view of the fact that the Project is scheduled to terminate at the end of next May, work has commenced on the preparation of a book which will include the results obtained by the various research fellows connected with the Project during the course of their investigations. It is also planned to include other useful data regarding silver and its alloys. It is expected that the publication will issue in the fall of 1940.

PREDICTION OF FLOOD WAVES

The intensive utilization of land along the banks of rivers has greatly increased the importance of the problems of flood prediction. The ability to predict floods depends to a large extent on a knowledge of their occurrence and behavior. The problems involved may be classified roughly as estimates of flood frequency, flood forecasting, and flood-wave prediction.

Estimates of flood frequencies are based on the history of previous floods, studied by statistical and physical principles in an attempt to determine what flows may be expected in the future, and the frequency with which they may occur. For example, the engineer may design his structures to resist the worst flood that will probably occur only once in 100 years.

The problem of estimating flood frequencies obviously is not the only one. Even if the flood-control works have been built, predictions from existing weather conditions as to the occurrence of floods are necessary in order that the works may be operated properly, and, if they are not adequate for complete protection, that those endangered may be notified. This problem, called flood forecasting, consists of applications of studies of the weather and conditions of the surface of the ground.

There is still another problem. After the flood waters have entered the river, there will be an increase in the height of the river, that is, a flood wave, which moves downstream. Cities located at considerable distances below the point where the abnormal flow entered the river may be endangered by this rising water when it arrives. The problem of flood-wave prediction is principally one of river hydraulics and aims to provide information as to the time that the flood peak will arrive at certain points and how high it will be, these data to be determined from the information about the progress of the high water at points upstream. The problem of flood-wave prediction is the one being studied in a projected series of researches, of which this is the first.

In a paper (R.P. 1272) in the January Journal of Research, G. H. Keulegan and George W. Patterson, of the Bureau's Hydraulics Laboratory, apply the principles of the hydrodynamics of a perfect fluid to changes in the originally horizontal water level in horizontal canals of uniform cross section, caused by the introduction of certain quantities of water at one end. The results also apply to waves generated in channels of uniform slope, carrying water initially at a uniform velocity. These methods are closely applicable to navigation canals and canals conveying water to and from hydroelectric stations. In these cases, the waves are established by filling or emptying the locks, and by sudden changes of load on the turbines. Another interesting application is to the breaking of waves rolling in over a sloping bottom.

A RATIONAL DEFINITION OF YIELD STRENGTH

Structures are frequently designed not only for strength but for stiffness, that is, in such a way that deformations will not be excessive. A common example is the floor of any structural steel building. A floor supported by steel beams might be overloaded to such an extent that although the overload would be far from causing collapse it would bend the beams permanently, leaving a noticeable sag in the floor. A property of materials which is used as a measure of the maximum load that will not produce excessive permanent deformation is called the yield strength. It is desirable that for two given materials these loads be proportional to the yield strengths of the materials. As the yield strength is ordinarily defined, this proportionality will not in general exist. In a paper by William R. Osgood, which has been submitted for publication in the Journal of Applied Mechanics, a definition is proposed that in many cases brings about the desired proportionality.

According to this definition, the yield strength is the stress determined by the intersection with the stress-strain curve of a line through the origin having a slope mE, where m lies between 0 and 1, and E is the modulus of elasticity.

THERMAL EXPANSION OF CHROMIUM-VANADIUM STEELS

Data on the linear thermal expansion of several SAE chromium-vanadium steels and information about their mechanical properties and uses have been published previously. RP1269 by

Peter Hidnert, in the Journal of Research for January, gives the results of an investigation on the linear thermal expansion of two other SAE chromium-vanadium steels (SAE 6125 and 6150), in the annealed condition and in the quenched and tempered condition. These steels were investigated at various temperatures between 20° and 650° C. The observations on cooling were found to be very close to the expansion curve, if the sample had previously been annealed or if it had been tempered at 650° C after quenching. The coefficients of expansion of the hardened sample tempered at 204° C (400° F) or 427° C (800° F) are less than the coefficients of expansion of the annealed sample. Tempering at 650° C 1,200° F) increased the expansion to that of the annealed sample. For the range from 20° to 650° C the average coefficients of expansion of all of the samples investigated vary from 13.8×10^{-6} to 14.8×10^{-6} per degree centigrade.

STRUCTURAL PROPERTIES OF "BENDER STEEL HOME" WALL CONSTRUCTION

Tests have been made at the Bureau on 21 specimens of sheet-steel wall constructions sold under the trade name "Bender Steel Home," and submitted by the Bender Body Co.

This wall construction consists of sheet-steel studs and outside face, with fiber insulating board inside face, and additional fiberboard insulation between the two. The steel, according to the sponsor's statement, is a nickel-copper alloy. Rivets and bolts are of the same material, and bolts are cadmium plated. Floors are sheet-steel panels, but partitions, roofs, and ceilings are of conventional wood-frame type.

As described in Building Materials and Structures Report BMS27, copies of which are now obtainable from the Superintendent of Documents, Government Printing Office, Washington, D. C., at 10 cents each, 4- and 8-foot wall specimens were subjected to compressive, transverse, concentrated, impact, and racking loads. The transverse, concentrated, and impact loads were applied to both faces of the specimens to simulate the actual loads applied to the walls of a house.

For each of the loads three like specimens were tested. The deformation under load and the set after its removal were measured for uniform increments of load, except for concentrated loads, for which the set only was determined. The results are presented in graphs and in a table.

WATERTIGHTNESS AND TRANSVERSE STRENGTH OF MASONRY WALLS

A pamphlet, summarizing in nontechnical language the results of the Bureau's work on rain penetration through masonry walls, has been prepared by Douglas E. Parsons, of the Masonry Construction Section, for publication by the Structural Clay Products Institute.

In this pamphlet it is pointed out that when masonry walls were subjected to conditions resembling exposure to rain and wind, some of them leaked badly in less than 3 minutes, while others withstood a severe test for more than 1 week. When leakage occurred it took place largely through openings in the joints. The resistance of the joints to leakage depended principally upon the method of laying the units; the walls which were most resistant contained either solidly filled vertical joints or a moisture barrier consisting of a plaster coating of mortar within the wall.

The watertightness of the joints also was affected by the suction rate of the bricks at time of laying and the working properties or water retentivity of the mortar. In general, it was found necessary to wet highly absorptive bricks before they were laid in order to obtain masonry highly resistant against rain penetration. In fact, the wetter the bricks at time of laying the greater the resistance. The tooling of the face joints assisted slightly in reducing leakage, but the permeability was governed largely by the nature of the joints in the interior of the walls.

Reducing the number of header bricks in walls of common American bond did not have a significant effect on the water permeability. Walls composed of a facing of low absorptive brick and a backing of highly absorptive brick gave better performances than similar walls constructed entirely of either type of brick. The resistance of walls with brick facings and hollow unit backings depended chiefly upon the permeablity of the facing.

Both the completeness of contact of mortar to brick and the tensile strength of brick-mortar joints were found to depend largely upon the method of forming the joints, the suction rates of the bricks at time of use, and the water retentivity and consistency of the mortar. The maximum strength of brick-mortar joints usually was obtained when the suction rate of the brick was between 0.2 and 1 oz per minute, the suction

rate being the amount of water absorbed by a brick when immersed flatwise to a depth of ⅛ in. for 1 minute. The strength of the joints tended to increase, also, with an increase in the water retentivity of the mortar, especially with bricks of moderate or high suction rates. Data obtained by M. O. Withey, of the University of Wisconsin, indicate that the most complete contact of mortar with brick, and joints of highest tensile strength are likely to be obtained if the mortar is as wet as may be used conveniently. The tensile strength of joints increased with an increase in strength of mortar, but not in direct proportion.

In summary, the results of the Bureau's research indicate that the most serviceable masonry walls are likely to be obtained when the joints are well filled, the suction rate of absorptive bricks is reduced by wetting prior to use, and when the mortar has satis factory working properties.

TESTS OF BRICK-CONCRETE-BLOCK AND CONCRETE-BLOCK WALL CONSTRUCTIONS

As part of the Bureau's investigation covering the structural properties of low-cost house constructions, tests were made on 48 specimens submitted by the National Concrete Masonry Association, Chicago, Ill. These specimens represented three wall constructions, two of which consisted of brick facing and concrete-block backing, the other of concrete blocks only.

The specimens were subjected to compressive, transverse, concentrated, impact, and racking loads. The transverse, concentrated, and impact loads were applied to both faces of the brick-concrete-block constructions, and for each loading condition, three like specimens were tested. The deformation under load and the set after its removal were measured for uniform increments of load, except for concentrated loads, for which the set only was determined.

The results of this work are presented by means of graphs and tables in Building Materials and Structures Report BMS32 which was released last month. The price is 10 cents a copy. Orders should be sent to the Superintendent of Documents, Government Printing Office, Washington, D. C.

GLASS IN PORTLAND CEMENT CLINKER

In J. Research NBS **21**, 355 (1938) RP1135, a method was described for determining quantitatively the constituents in portland cement clinker by the microscopic analysis of polished surfaces of clinker after etching with suitable reagents. The results of the quantitative microscopic analyses of a number of samples of commercial portland cement clinkers were compared with the results obtained by the calculation of constituents from chemical analysis. For a few of these samples, the values for glass obtained microscopically were compared with the values found by an independent method involving the heat of solution of the clinkers (J. Research NBS **20**, 77 (1938) RP1066). It was found that the values for "light interstitial" material obtained microscopically were, for many samples, considerably in excess of those for $4CaO.Al_2O_3.Fe_2O_3$ calculated from the chemical composition, whereas the values for glass obtained microscopically were less than those found by the heat-of-solution method. It was concluded in RP1135 that the "light interstitial" material was a single phase, because none of the etching reagents used caused any differentiation of this material.

Since the publication of RP1135, renewed effort has been made to find reasons for the discrepancies between the results of the miscroscopic analysis and the results of the other methods used. This has led to a search for reagents that might attack the "light interstitial" material. A reagent recommended by Tavasci (Giorn. Chim. Ind. Applicata **16**, 538 (1934)) composed of 4 parts of 10-percent NaOH and 1 part of 10-percent $Na_2H\ PO_4$ and used at 50° C is found to attack all the interstitial material and, therefore, is not suitable for differentiation. Further search has shown that strongly alkaline solutions under carefully controlled conditions of time, temperature, and concentration etch portions of the "light interstitial" material. The most satisfactory reagent found is a 10-percent solution of KOH. The polished specimen is agitated in this solution for 15 seconds at a temperature of 29° C. Microscopic examination of polished thin sections of clinker etched with the alkaline solution show definitely that the etched portions of the "light interstitial" material contain isotropic material with a high index of refraction and a dark-green color, whereas the unetched portions are distinctly birefringent, with high indices of refraction and frequently strong pleochroism. It is assumed from the optical properties that the etched material is a glass containing a high percentage of iron, and that the unetched material is

essentially the crystalline compound $4CaO.Al_2O_3.Fe_2O_3$.

The clinker specimens analyzed microscopically in RP1135 have been reanalyzed after etching with the new reagent. The results are to appear in a forthcoming paper together with a more detailed description of the etching technique and photomicrographs showing the effects of the reagent on the polished specimens. In general, the reanalysis gives lower values for "light interstitial" material and higher results for glass than the first microscopic analysis. The values for glass are more nearly in agreement with the values found by the heat-of-solution method.

EFFECT OF BRONZE ON MARBLE

A series of exposure tests has been started to determine if bronze work mounted above marble may affect the durability of the marble. It has long been known that bronze will cause green or brown discolorations on marble, but some cases have indicated that there is a more serious effect. Green stains are evidently caused by the copper component of the bronze but the cause of disintegration is not known.

Experiments are in progress on three compositions of bronze, as follows:

(1) 90 parts copper, 8 parts tin, 2 parts lead;

(2) 88 parts copper, 10 parts tin, 2 parts zinc;

(3) 80 parts copper, 3 parts tin, 16 parts zinc, 1 part lead.

The bronzes were cast in the form of round bars and turned on a lathe in order to produce shavings. These were used in the tests, so that a large area of bronze was exposed to rain water. Containers made of sheet bronze in the form of boxes, open at top and bottom, were placed upon white calcite marble specimens 4 by 1½ by 24 in. in size. The containers holding 1,800 grams of bronze shavings were attached at the middle of each marble specimen. Fifteen specimens were made for each type of bronze and 15 more were exposed in a similar manner without bronze in contact, for control purposes. Since the composition of the bronze boxes was somewhat different from the bronze samples, a few tests were added in which only the boxes were attached to the marble slabs. These were used to determine if the small amount of bronze in the boxes would cause any appreciable differences.

The specimens have now been exposed to the weather for 18 months and the following observations have been made:

The turnings from bronze 1 have changed somewhat in color from the original golden shade to a depth of about ¼ in., while underneath this layer there has been no appreciable change.

The turnings from bronze 2 have become gray, resembling zinc, to a depth from ½ to 1 in.

Those for bronze 3 became gray like bronze 2 to a depth of about ½ in.

Brown stains have formed on the top surfaces of the marble slabs, extending about ½ in. away from the boxes. These were pronounced for bronzes 1 and 2, but less so for bronze 3. Green stains have formed only on the edges of the marble and they are very faint. A few slabs which had been treated with a sealer show no brown stains, but green stains on the edges are as marked as on those not treated.

CHIPPING RESISTANCE OF CHINAWARE

In 1929 the Bureau published the results of so-called chipping and impact tests on plates of 4 representative brands of American fine earthenware ("semi-porcelain"). These tests, reported in the J. Am. Ceramic Soc. 12, 716 (1929), were made with the apparatus described in Federal Specification M–C–301, and are designed to evaluate resistance to mechanical shock. Weight, diameter, rim thickness, and absorptivity also were determined. During the past year the same determinations were made, under the direction of R. F. Geller, on recently manufactured specimens of the same four brands and the comparative average values are given in the table.

Property measured	1929	1939
Diameter, in	8.9	9.2
Weight, oz	14.0	14.9
Rim thickness, in	0.17	0.15
Water absorption, percent	9.4	8.5
Impact, ft lb	0.22	0.22
Chipping, ft lb	.048	.119

It is interesting to note the marked improvement in resistance to chipping which has been accomplished by the industry during the past 10 years, especially in view of the decrease in rim thickness.

INFRARED ARC SPECTRUM OF GERMANIUM

The element germanium shares with gallium and scandium the distinction of having its existence foretold and its properties described prior to its actual discovery. In 1871 Mendeléeff announced his periodic classification of the chemical elements and predicted three new members to occupy the gaps in the table as it then existed. The final verification of his predictions occurred in 1886 when Winkler discovered a new element, germanium, with the properties ascribed by Mendeléeff to eka-silicon. The element is rare and only small amounts have been prepared in a pure state.

For theoretical reasons it is known that a portion of the arc spectrum of germanium must lie in the infrared. The more intense lines in this region have now been recorded on the specially sensitized plates of the Eastman series with the grating spectrographs of the Bureau. C. C. Kiess has classified most of the new lines as combinations between the previously known $^3P°$ and $^1P°$ terms of the $5s$ configuration with new triplet and singlet terms of the $5p$ configuration. The yellow lines observed by Lunt in spark and discharge tube sources are found to be lines of Ge I and, in analogy with similar lines of C I and Si I, probably owe their origin to the $5s—6p$ transition.

The complete account of this work will be published as RP1266 in the Journal of Research for January.

COLORIMETRIC DETERMINATION OF ARSENIC

A method developed by Clement J. Rodden, of the Chemistry Division, for the determination of arsenic in iron, steel, copper-base alloys, tin- and lead-base bearing metals and pig lead is given in the January number of the Journal of Research (RP1267). The arsenic is separated from the other constituents by distilling as the trichloride. It is then converted to a blue arsenic-molybdenum compound, and the amount of arsenic is obtained from transmittancy measurements by using a photoelectric colorimeter. The color may also be matched against standards by means of a visual colorimeter. The method is reasonably rapid and is applicable to amounts of arsenic as small as 2 micrograms.

DETERMINATION OF URONIC ACID IN CELLULOSIC MATERIALS

Naturally occurring cellulosic fibers appear to be a more or less intimate association of cellulose with other constituents, generally referred to as incrusting substances. A portion of these extraneous materials appears to be composed of uronic acids, presumably contained in the pectic substances of the fibers. Many of the important properties of these fibers, such as tensile strength, moisture, and dye absorption, and viscosity in cuprammonium solution have frequently been considered as related to the presence of small quantities of pectin. In order to study this relationship in greater detail, it was necessary to develop a method for the quantitative estimation of pectin or its constituent uronic acids.

Available methods, based on the evolution of carbon dioxide during treatment of the uronic acid with a boiling solution of hydrochloric acid, were found to fail when cellulose or other carbohydrate materials were present, since these substances also decompose with the evolution of some carbon dioxide. An investigation of the rates of evolution of carbon dioxide showed that pure uronic acids evolved carbon dioxide at a rapid rate and that the evolution of gas was complete in several hours. On the other hand, carbohydrates, free of uronic acids, evolved carbon dioxide at a much slower but approximately constant rate during the entire treatment. It was found that this difference in rates could be utilized for the estimation of uronic acids, even when they are mixed with large proportions of cellulosic materials. A detailed description of the apparatus and its manipulation is given in a paper by Roy L. Whistler, A. R. Martin, and Milton Harris (RP1268), which will be published in the Journal of Research for January.

PHYSICAL PROPERTIES OF ALIPHATIC HYDROCARBONS

In RP1271, to be published in the January number of the Journal of Research, will be found a description of materials prepared by Donald B. Brooks, Frank L. Howard, and Hugh C. Crofton, Jr. in connection with an investigation of the suitability of paraffin hydrocarbons as constituents of aviation fuel. This investigation is being

conducted at the Bureau for the National Advisory Committee for Aeronautics, the Navy Bureau of Aeronautics, and the Army Air Corps. In an earlier report the properties of purified 2,2,3-trimethylpentane were described. This paper adds seven paraffins and four olefins to the list. Eight of these hydrocarbons were synthesized, one was isolated from a commercial synthetic crude, and two were obtained from commercial sources. All were purified by distillation in automatically controlled fractionating columns of high efficiency.

The measured physical properties of these materials included freezing point, boiling point and its variation with pressure, and refractive index and density and their variations with temperature. Since, in most cases, the samples are believed to be purer than previous preparations, the values obtained are believed to be more accurate than those reported heretofore.

COMMERCIAL STANDARD FOR AUTOMATIC MECHANICAL DRAFT OIL BURNERS

Commercial Standard CS75–39, Automatic Mechanical Draft Oil Burners Designed for Domestic Installations, has just been released.

This standard is intended to serve as a basis for better understanding between buyers and sellers. It includes specific requirements for oil burner construction, safety, manufacturing and production tests, laboratory performance tests, and performance requirements and tests to be made by the contractor after installation of the individual burner. Also, it describes the wording of a certificate which is to be posted in the basement along with each oil burner installation, setting forth the manufacturer's warranty; data applying to the particular installation, such as the amount of standing radiation; the results of tests by the installing contractor, recording the grade of fuel oil used, the draft over the fire and at the breeching, the percentage of CO_2 in the flue gases, the stack temperature, and the firing rate.

The pamphlet also includes a section on the significance of installation requirements and performance tests, for the benefit of those who may not be familiar with the subject.

It is expected that a wide use of the certificate and the seal of the official inspection agency of the oil burner industry, evidencing compliance with the commercial standard, will result in a distinct improvement in the quality and performance of mechanical draft oil burners, while purchasers will be provided with a definite basis for checking and comparing their performance.

The standard became effective for new production on November 1, 1939. Copies are for sale by the Superintendent of Documents, Government Printing Office, Washington, D. C., at 5 cents each.

CORRUGATED METAL DIAPHRAGMS FOR AIRCRAFT PRESSURE MEASURING INSTRUMENTS

Metallic diaphragms, singly or in pairs as capsules, find a wide use in pressure measuring instruments of many types. The compactness, simplicity, and cheapness of diaphragms, and the wide range of load, sensitivity, and deflection characteristics available, recommend their use, especially in aircraft instruments. However, in practice, certain limitations confront the designer who wishes to make use of diaphragms in any given application. For one thing, there are no rational design formulas which enable one to predict the behavior or performance of corrugated diaphragms. Even for the limiting case of flat disks, where theory has led to the development of performance equations, convenient charts, tables, or other aids to design are not yet available. The use of corrugated disks makes possible larger deflections, and affords a control of the shape of the pressure-deflection curve. It is possible to set theoretical limits to the gain in deflection which can be achieved by corrugating the disks, but there has been no way of predicting, except in a general qualitative fashion, the performance to be expected for a given type of corrugation. This is a serious practical difficulty, since it is always desirable to use the diaphragm best suited to the specific application, and selecting the best form of diaphragm by the trial and rejection method may involve considerable development expense.

To obtain data with which more precise design might be achieved, a large number of corrugated diaphragms having geometrically similar outlines were formed by hydraulic pressing. The diaphragms were made of beryllium copper, phosphor bronze, and Z-nickel in various diameters and thicknesses. The relations between measured pressures and deflections of the diaphragms were correlated by dimensional analysis to obtain formulas and charts applicable to the design of similar diaphragms.

These data were compared with those available on flat diaphragms, and on diaphragms with different types of corrugation.

The results obtained, together with a description of the apparatus and technique used in the manufacture, testing, and heat treatment of the diaphragms, and a discussion of the general method of designing corrugated diaphragms, have been published by W. A. Wildhack and V. H. Goerke in Technical Note No. 738 of the National Advisory Committee for Aeronautics.

ANEROID DIAPHRAGM CAPSULE

A sensitive diaphragm capsule has been designed by W. G. Brombacher, V. H. Goerke, and F. Cordero, of the Bureau's Aeronautic Instruments Section, in which the two corrugated diaphragms nest into each other at external air pressures above a desired value. Evacuated capsules of this type have particular application in measuring pressure with radio sondes of the Diamond-Hinman-Dunmore type where the deflection of the contact arm is fixed. At the ground level the diaphragms are designed to nest into each other, and deflection does not begin until the air pressure is reduced to the value called the cut-off pressure. Several elements of 2 capsules each were constructed with a cut-off pressure of 140 millibars. When installed in a radio sonde in place of the usual type, which is responsive over the entire range of pressures, a sevenfold increase in sensitivity in pressure measurement was obtained at altitudes above 46,000 feet.

The complete description of this capsule will be published as RP1270 in the January number of the Journal of Research.

NEW AND REVISED PUBLICATIONS ISSUED DURING DECEMBER 1939

Journal of Research [2]

Journal of Research of the National Bureau of Standards, volume 23, number 6, December 1939 (RP1259 to RP1265, inclusive). Price 30 cents. Annual subscription, 12 issues, $3.50.

Journal of Research of the National Bureau of Standards, title page, corrections, and contents to volume 22, January to June 1939 (RP1162 to RP1217, inclusive). Free on application to the Bureau.

Research Papers [2]

[Reprints from the September and October 1939 Journal of Research]

RP1239. Method of designating colors. Deane B. Judd and Kenneth L. Kelly. Price 10 cents.

RP1240. Dropping tests for measuring the thickness of zinc and cadmium coatings on steel. Abner Brenner. Price 10 cents.

RP1243. Length changes and endothermic and exothermic effects during heating of flint and aluminous clays. Raymond A. Heindl and Lewis E. Mong. Price 5 cents.

RP1244. Second spectrum of chlorine and its structure. C. C. Kiess and T. L. deBruin. Price 10 cents.

RP1245. Electrophoretic studies of wool. Arnold M. Sookne and Milton Harris. Price 5 cents.

RP1246. Radium exposure meter. Leon F. Curtiss. Price 5 cents.

RP1247. Determination of optimum voltage for airplane electric systems. Vernon H. Grant and Melville F. Peters. Price 5 cents.

RP1248. Separation and colorimetric determination of rhenium and molybdenum. James I. Hoffman and G. E. F. Lundell. Price 5 cents.

RP1249. Reflux regulator and head for laboratory rectifying columns. Frederick D. Rossini and Augustus R. Glasgow, Jr. Price 5 cents.

RP1250. Soil-corrosion studies, 1937. Corrosion-resistant materials and special tests. Kirk H. Logan. Price 10 cents.

RP1251. X-ray studies of compounds in the system PbO-SiO_2. Howard F. McMurdie and Elmer N. Bunting. Price 5 cents.

Building Materials and Structures [2]

[Persons who wish to be notified of new publications in the "Building Materials and Structures" series as soon as they are available, should write to the Superintendent of Documents, Government Printing Office, Washington, D. C., asking that their names be placed on the special mailing list maintained by him for this purpose.]

During the past month the following publications in this series have been issued:

BMS27. Structural properties of "Bender Steel Home" wall construction sponsored by The Bender Body

[2] Send orders for publications under this heading only to the Superintendent of Documents, Government Printing Office, Washington, D. C. Subscription to Technical News Bulletin, 50 cents per year; Journal of Research $3.50 per year (United States and its possessions, and Canada, Colombia, Cuba, Dominican Republic, Ecuador, Guatemala, Honduras, Mexico, Newfoundland (including Labrador), Panama, and Venezuela); other countries, 70 cents and $4.50, respectively.

Co., Herbert L. Whittemore, Ambrose H. Stang, and Vincent B. Phelan. Price 10 cents.

BMS32. Structural properties of two brick-concrete-block wall constructions and a concrete-block wall construction sponsored by the National Concrete Masonry Association. Herbert L. Whittemore, Ambrose H. Stang, and Douglas E. Parsons. Price 10 cents.

Simplified Practice Recommendations [2]

R77–39. Hickory handles. (Supersedes R77.) Price 5 cents.

Commercial Standards [2]

CS75–39. Automatic mechanical draft oil burners designed for domestic installations. Price 5 cents.

Technical News Bulletin [2]

Technical News Bulletin 272, December 1939. Price 5 cents. Annual subscription, 50 cents.

MIMEOGRAPHED MATERIAL

Letter Circulars

[Letter Circulars are prepared to answer specific inquiries addressed to the National Bureau of Standards and are sent only on request to persons having definite need for the information. The Bureau cannot undertake to supply lists or complete sets of Letter Circulars or send copies automatically as issued.]

LC569. Gypsum: Publications by the staff of the National Bureau of Standards. (Supersedes LC145.)

LC574. Paint, varnish, and bituminous materials: Publications by members of the staff of the National Bureau of Standards and a list of Federal Specifications. (Supersedes LC291.)

LC575. The ionosphere and radio transmission conditions with special reference to the observing and reporting service of the National Bureau of Standards.

LC576. Inorganic analytical chemistry: Publications by the staff of the National Bureau of Standards. (Supersedes LC536.)

LC577. Leather: Publications by the staff of the National Bureau of Standards. (Supersedes LC176.)

LC578. Sources of radio information. (Supersedes LC513.)

[2] See footnote two p. 9.

RECENT BUREAU ARTICLES APPEARING IN OUTSIDE PUBLICATIONS [3]

Outline of the cooperative dental research between the National Bureau of Standards and the American Dental Association, 1938–1939. George C. Paffenbarger. J. Am. Dental Assn. (212 East Superior St., Chicago, Ill.) **26**, 1728 (November 1939).

Denture base material: Acrylic resins. W. T. Sweeney. J. Am. Dental Assn. **26**, 1863 (November 1939).

Die fermentative spaltung von laktose, laktulose, und neolaktose. B. Helferich and W. W. Pigman. Ber. Deut. Chem. Ges. (Berlin, Germany) **72**, 212 (1939).

Die frage der spaltbarkeit von methylglykosiden einiger synthetischer zucker durch Süssmandel emulsion. B. Helferich, W. W. Pigman, and H. S. Isbell. Z. Physiol. Chem. (Berlin, Germany) **261**, 55 (1939).

Die spaltbarkeit von lactobionsäure durch Süssmandel-emulsion. B. Helferich, W. W. Pigman, and H. S. Isbell. Z. Physiol. Chem. **261**, 189 (1939).

Preliminary measurements of ozone over Mount Evans, Colo. R. Stair and I. F. Hand. Trans. Am. Geophysical Union (National Research Council, Washington, D. C.) part III, 338 (1939).

A comparison of colorimetric and polarographic methods in relation to the cystine content of insulin. M. X. Sullivan, W. C. Hess, and E. R. Smith. J. Biol. Chem. (Williams and Wilkins Co., Mount Royal and Guilford Aves., Baltimore, Md.) **130**, 741 (October 1939).

Corrugated metal diaphragms for aircraft pressure-measuring instruments. W. A. Wildhack and V. H. Goerke. Nat. Advis. Com. Aero. Tech. Note No. 738 (National Advisory Committee for Aeronautics, Washington, D. C.) (November 1939).

New method of testing accelerometers. B. W. Woolard. Instruments (1117 Wolfendale St., Pittsburgh, Pa.) **12** 322 (December 1939).

Photochemical decomposition of the cystine in wool. Henry A. Ruther-

[3] These publications are not obtainable from the Government, unless otherwise indicated. Requests should be sent direct to the publishers.

ford and Milton Harris. Am. Dyestuff Reporter (440 Fourth Ave., New York, N. Y.) **28**, No. 23, 655 (November 13, 1939); Textile Research (65 Franklin St., Boston, Mass.) **10**, No. 1, 17 (November 1939).

Tide water and weather exposure tests of metals used in aircraft. W. H. Mutchler and W. G. Galvin. Nat. Advis. Com. Aero. Tech. Note No. 736. (November 1939).

The elastic properties of cast iron. A. I. Krynitsky and C. M. Saeger. Metallurgia (The Kennedy Press, Ltd., 21 Albion St., Gaythorn, Manchester 1, England) **20**, 213 (October 1939).

Opportunities for women chemists in Washington. Ruby K. Worner. J. Chem. Education (Kent Chemical Laboratory, University of Chicago, Chicago, Ill.) **16**, 583 (December 1939).

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